Issues related to the design of a deep geological repository in Opalinus Clay: Parameter study with a conventional design model

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Within the current phase of the Swiss Sectorial Plan for Deep Geological Repositories construction feasibility has to be assessed for a variety of potential boundary conditions such as host rock mechanical properties and in-situ stress conditions or overburden respectively. Construction feasibility can be defined as meeting the design requirements in terms of stability and safety of the openings in accordance to the Swiss Codes and serviceability according to the needs of a geological repository (e.g. long-term safety). The requirements related to serviceability include performance indicators such as deformation (convergence) and size of the plastic zone.

The design is assessed based on rock mechanical and structural analysis for relevant hazard scenarios on an ultimate limit state (stability) and a serviceability state level (operational and long-term safety requirements), using standard design tools.

The tools used are:

- Closed form solutions: E.g. ground reaction curves, Barlow's formula etc. to develop an understanding about the general response of a system and to countercheck the results of the more sophisticated types of analysis as mentioned below.
- Frame Analysis: The response of a potential lining of the tunnels to several load cases and load combinations was simulated assuming elastic and/or elasto-plastic beams bedded on compression springs representing the surrounding rock mass.
- Continuum Analysis: Numerical tools were used to take into account the interaction between the rock-mass, represented by its specific characteristics - e.g. strength anisotropy, hydro-mechanical coupling and post-failure softening - the lining system and the excavation process.

The host rock exhibits an inherent variability in its relevant geo-mechanical properties, e.g. matrix and bedding strength, structural variability, in-situ stress regime etc. Besides a sound understanding of the mechanisms and processes relevant for ensuring stability and serviceability addressing the variability and its implication on the analysis is one of the key issues for design. The study is not an accurate and precise prediction of the system's response to the most probable loading scenario, but rather rock-mass behavior and lining characteristics that include scenarios which are unlikely but still plausible to assess stability and serviceability of underground structures; the requirements have to be met also for unfavorable conditions. The presentation will reveal and discuss some intermediate results of parametric studies covering a variety of rock mechanical conditions using different design models and tools.